CLAIMS

What is claimed is:

1. A focus-position compensator for reducing focus variations on a microlens array, the focus-position compensator comprising:
a plurality of tiles, each tile having a tile refractive index and a tile thickness, the tile refractive index for each tile being substantially uniform over the tile, and the tile thickness being substantially uniform over the tile, the tile refractive index and the tile thickness being chosen to obtain a tile focus-position correction, at least two of the tiles having different tile focus-position corrections, the plurality of tiles being disposed in relation to the microlens array such that effects of focus variations of the microlens array are reduced.

2. The focus-position compensator, according to claim 1, wherein any of the tiles is made from: glass, sapphire, fused silica, calcite, quartz, Calcium Fluoride, Magnesium Fluoride, Zinc Selenide, Zinc Sulfide, Germanium, Silicon, Gallium Arsenide, Gallium Phosphide, Aluminum Gallium Arsenide, Indium Gallium Arsenide, or KRS5.

3. The focus-position compensator, according to claim 1, wherein the plurality of tiles are affixed to a window disposed between the microlens array and a plurality of optical fibers.

4. The focus-position compensator, according to claim 3, wherein any of the tiles is made from: glass, sapphire, fused silica, calcite, quartz, Calcium Fluoride, Magnesium Fluoride, Zinc Selenide, Zinc Sulfide, Germanium, Silicon, Gallium Arsenide, Gallium Phosphide, Aluminum Gallium Arsenide, Indium Gallium Arsenide, or KRS5.

5. The focus-position compensator, according to claim 1, wherein the plurality of tiles are affixed to the microlens array.

6. The focus-position compensator, according to claim 5, wherein each tile has a rectangular planform.

7. The focus-position compensator, according to claim 6, wherein the tiles are attached to the microlens array by adhesive free bonding.

8. The focus-position compensator, according to claim 6, wherein the tiles are attached to the microlens array with UV curing cement.

9. The focus-position compensator, according to claim 8, wherein all the tiles have approximately the same index of refraction.

10. The focus-position compensator, according to claim 5, wherein any of the tiles is made from: glass, sapphire, fused silica, calcite, quartz, Calcium Fluoride, Magnesium Fluoride, Zinc Selenide, Zinc Sulfide, Germanium, Silicon, Gallium Arsenide, Gallium Phosphide, Aluminum Gallium Arsenide, Indium Gallium Arsenide, or KRS5.

11. The focus-position compensator, according to claim 1, wherein the plurality of tiles are affixed to a fiber-block window connected to the plurality of optical fibers.

12. The focus-position compensator, according to claim 11, wherein the fiber-block window is comprised of glass or silica.

13. The focus-position compensator, according to claim 11, wherein any of the tiles is made from: glass, sapphire, fused silica, calcite, quartz, Calcium Fluoride, Magnesium Fluoride, Zinc Selenide, Zinc Sulfide, Germanium, Silicon, Gallium Arsenide, Gallium Phosphide, Aluminum Gallium Arsenide, Indium Gallium Arsenide, or KRS5.

14. A method of making a focus-position compensator for a microlens array having a substrate, the method comprising the steps of:

determining the spatial variation of focus distance of the microlens array;

choosing a number of tiles, a spatial distribution of tiles, and a tile focus-position correction Δ_i of the i-th tile, such that the focus variation of the microlens array is reduced to within a desired limit;

selecting a tile thickness t_i of the i-th tile and a tile refractive index n_i, so as to obtain the chosen tile focus-position correction Δ_i,

choosing a reference thickness t_{ref}, the reference thickness being greater than or equal to the maximum tile thickness;

determining a spacer-block thickness s_i corresponding to the i-th tile such that $s_i = t_{ref} - t_i$;

constructing tiles, the i-th tile having thickness t_i;

constructing spacer blocks for all $s_i > 0$, the i-th spacer block having thickness s_i;

micromachining a tile tray, the tile tray having a receptacle for receiving each tile, the i-th receptacle being positioned to receive the i-th tile;

for $s_i > 0$, placing the i-th spacer block in the i-th receptacle;

placing the i-th tile in the i-th receptacle, wherein for $s_i > 0$, i-th tile is disposed on top of the i-th spacer block;

placing an intervening structure on top of the tiles;

bonding the tiles to the intervening structure;

removing the tile tray and the spacer blocks.

15. The method, according to claim 14, wherein:

the bonding is adhesive free bonding.

16. The method, according to claim 14, wherein:

the bonding comprises:

placing a curable bonding material on top of each tile prior to placing the intervening structure on top of the tiles; and

curing the curable bonding material after placing the intervening structure on top of the tiles.

17. The method, according to claim 16, wherein:

the intervening structure is a window placed between the microlens array and a plurality of optical fibers;

and further comprising the step of:

aligning the window with the microlens array.

18. The method, according to claim 16, wherein:

the intervening structure is a fiber-block window connected to a plurality of optical fibers;

and further comprising the step of:

aligning the tile tray with the optical fibers prior to curing the curable bonding material.

19. The method, according to claim 16, wherein:

the intervening structure is the substrate of the microlens array;

and further comprising the step of:

aligning the tile tray with the microlens array prior to curing the curable bonding material.

20. The method, according to claim 19, wherein each tile is made from glass.

21. The method, according to claim 19, wherein each tile is made from silica.

22. The method, according to claim 19, wherein the tile tray is rectangular and the receptacles are rectangular and evenly spaced.

23. The method, according to claim 19, wherein the tile tray is made from Silicon and the micromachining is done with Deep Reactive Ion Etching (DRIE).

24. The method, according to claim 19, wherein the curable bonding material is UV curing cement.

25. The method, according to claim 19, wherein a microscope and X-Y positioners and a rotation stage are used to align the tile tray and the microlens array.

26. The method, according to claim 25, wherein the tile tray and the microlens array are aligned to within 10 μm.